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**BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES**

Application Number: 10/693,373
Filing Date: October 24, 2003
Appellant(s): BORODOVSKY, YAN

**MAILED
SEP 07 2007
GROUP 1700**

John F. Conroy
For Appellant

EXAMINER'S ANSWER

This is in response to the appeal brief filed May 29, 2007, appealing from the Office action mailed November 30, 2006.

(1) Real Party in Interest

A statement identifying by name the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

(3) Status of Claims

The statement of the status of claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Claimed Subject Matter

The summary of claimed subject matter contained in the brief is correct.

(6) Grounds of Rejection to be Reviewed on Appeal

The appellant's statement of the grounds of rejection to be reviewed on appeal is correct.

Note that EP 0915384 "Canon" is the same as Examiner's EP 0915384 "Sugita".

(7) Claims Appendix

The copy of the appealed claims contained in the Appendix to the brief is correct.

(8) Evidence Relied Upon

EP 0915384 (Sugita et al., hereinafter referred to as Sugita) May 12, 1999.

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5415835

Brueck et al., hereinafter

05-1995

referred to as Brueck

(9) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

2. Claims 10-12, are rejected under 35 U.S.C. 102(b) as being anticipated by EP 0915384 (Sugita et al., hereinafter referred to as Sugita).

Sugita, in [0018], [0019], [0020], [0021], [0022], [0023], [0038], [0064], [0065], [0066], [0091], [0092], discloses exposing a photoresist coated wafer to an interference patterns in an interference exposure apparatus, to form a periodic pattern (line and space pattern, an exposed array of patterns), performing a second exposure in a different apparatus different from the interference exposure apparatus to form a pattern on the photoresist with a pitch twice as large as the first pitch (pitch of the interference pattern). Sugita, in [0105], discloses that the second linewidth is less than that of the first line width (claims 10 and 11). Sugita, in [0090], and [0091], discloses that the pitch of the interference pattern is about half wavelength (claims 12).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claims 1-3, 5, 7, and 25-27, are rejected under 35 U.S.C. 103(a) as being unpatentable over EP 0915384 (Sugita et al., hereinafter referred to as Sugita) in view of U. S. Patent No. 5,415,835 (Brueck et al., hereinafter referred to as Brueck).

Sugita, in [0018], [0019], [0020], [0021], [0022], [0023], [0038], [0064], [0065], [0066], [0067], [0091], [0092], discloses exposing a photoresist coated wafer to an interference patterns in an interference exposure apparatus, to form a periodic pattern (line and space pattern, an exposed array of patterns i.e., for positive resists unexposed lines and exposed spaces are produced), performing a second exposure in a different apparatus different from the interference exposure apparatus to form a pattern on the photoresist with a pitch twice as large as the first pitch (pitch of the interference pattern). Sugita, in [0073], and [0105], discloses that the second linewidth can be less than that of the first line width. Sugita, in [0021], [0022], discloses that the second exposure can be performed with masks having different patterns (claims 1, 3, and 25-26). Sugita, in [0026], discloses that the second exposure can be a lens-based lithography (projection lens) (claim 27). Sugita, in [0064], [0065], and in figures 2A, and 2B, discloses that the first line width and second linewidth are equal (claim 2). Sugita, in [0087], [0088], and in figure 16, discloses a beam splitter (claim 5). Sugita, in [0103], discloses that the

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second apparatus is a mask-based lithography tool (claim 7). Sugita, in [0113], [0114], [0116], discloses an alignment optical system (alignment sensor) that observes the alignment mark on the wafer for the interference pattern formed in the first exposure, and observes the alignment mark on the wafer (with interference pattern formed) for the projection exposure process (second patterning system) performed on the exposed wafer. Sugita, in [0115], and in figure 21, discloses a system that enables the interference exposure apparatus (first patterning system) and the projection optical exposure apparatus (second patterning system, imprint system) to perform a first and second exposure on the wafer via a reticle to form a reduced pattern on the wafer positioned on the wafer stage.

The difference between the claims and Sugita is that Sugita does not disclose using the alignment system to align the lines that are remaining unexposed to radiation (from the first exposure) to trim and narrow the first width of at least some of the unexposed lines.

Brueck, in col 2, lines 60-68, and in col 8, lines 40-65, discloses that the second exposure pattern is re-positioned such that the unexposed portions (lines) of the resist from the first interference exposure is exposed during the second exposure and results in a second line width that is smaller than the first linewidth (i.e., the second exposure trims and narrows the first width).

Therefore, it would be obvious to a skilled artisan to modify Sugita by using the alignment system to align and perform exposure to non-exposed areas as suggested by Brueck because Sugita, in [0113] that the alignment system is re-positionable to any

desired position relative to the alignment mark, and Sugita, in [0074], and [0086], discloses that the resultant linewidth of the interference pattern formed can be reduced further by adjusting the angles at which the light beams are incident on the wafer, and by adjusting the exposure amount distribution.

(10) Response to Argument

Claim 10

A) Appellant argues that Canon's (hereinafter referred to as Sugita) multiplex exposure amounts are achieved when three or more exposures levels are used and that this contrast with two exposure levels of a binary exposure level system.

Sugita, in the abstract, in paragraph no. [0063], and in figure 1, discloses an embodiment wherein the process includes an interference exposure step, a second projection exposure step followed by a development i.e., only two exposure processes are performed in this embodiment. Therefore, Sugita teaches forming a pattern with only two exposure processes, and does not require a multiple exposure process in all the different embodiments.

B) Appellant argues that none of the features in Sugita have a width that is less than the width of the non-exposed lines of Sugita's interference patterns.

Sugita, in [0071], and [0074], and in figures 7A, and 7B (illustrated below), discloses that the linewidth (second width) of the line and space pattern (positive resist producing unexposed line and exposed space pattern, line width of the pattern in figure

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7B) is less than the linewidth of the line (first width of the non-exposed line) formed after the first interference exposure (linewidth of line in figure 7A).

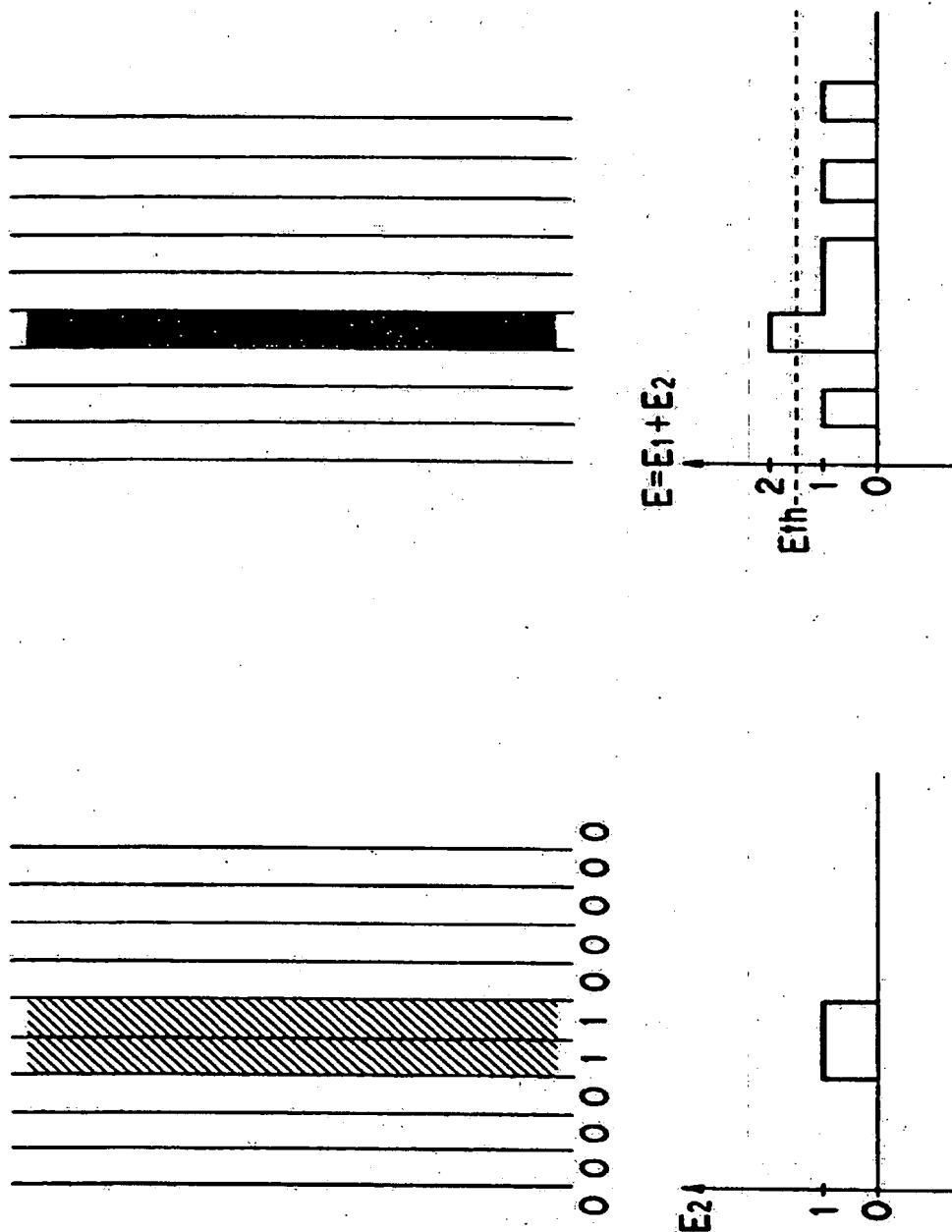


FIG. 7B

FIG. 7A

Appellant is arguing embodiments such as figures 11A through 11D, and figures 9A, and 9B that are not relied upon by the examiner. Furthermore, Appellant is arguing a

limitation not recited in claim 10 i.e., claim 10 does not recite that the second width is that of the non-exposed line. Claim 10 recites a first width of a non-exposed line, and a second width of at least one line exposed to radiation. Claim 10 does not recite that the at least one line that form features of a second width is the non-exposed line.

C) Appellant argues that Sugita does not disclose exposing a portion of at least one line to radiation to form features with a second width that is less than the width of the non-exposed lines of the interference pattern.

See argument and illustration in B). Sugita, in [0071], [0073], and [0074], discloses a first linewidth that is larger than the second linewidth, and that the exposure distribution is adjusted such that a minimum linewidth (second width) can be produced.

Claim 25

A) Appellant argues that Brueck's crossed grating patterns does not disclose trimming and narrowing a width of at least some of the non-exposed lines of an interference pattern by exposing portions of the non-exposed lines using a second exposure.

Brueck, in col 2, lines 46-52, in col 6, lines 34-36, and in col 8, lines 42-58, discloses that the non exposed areas (non exposed lines) is subjected to a second exposure and that the first exposure pattern (grating) has a period of 1μ which corresponds to a line width of 0.5μ , and that the final pattern of the line-space pattern has a linewidth of 100nm i.e., 0.1μ . Therefore the second exposure process performed

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does trim the linewidth of the features (non exposed lines) from the first exposure i.e., trims the width from 0.5μ to 0.1μ .

B) Appellant argues that Brueck's crossed interferometric exposures cannot be combined with Sugita's multiplex exposure to arrive at the claimed or recited subject matter.

Brueck is not relied upon for its cross grating patterns. Also, see argument A). Brueck is relied upon to show that the unexposed lines can be exposed further so as to form line widths that are trimmed i.e., smaller than the first line width (resulting from the first interference exposure) see column 8, lines 40-58, column 2, lines 43-48, and column 6, lines 33-36. Additionally, Brueck, in col 2, lines 43-46, discloses that the two dimensional pattern can be either interconnected or unconnected straight lines spaced apart from each other (line and space patterns) i.e., Brueck's invention is not limited to cross grating patterns as argued by the appellant. Furthermore, Sugita is not limited to a multiplex exposure embodiment; Sugita, in figure 1, teaches a first interference exposure process and a second exposure process. See argument A) of Claim 10.

C) Appellant argues that there is no reason to believe that the combination of Brueck and Sugita leads to the recited subject matter.

The motivation to combine Brueck with Sugita is disclosed in paragraph no. 4 of the rejection. Also see argument addressed in paragraph B) pertaining to Claim 25.

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D) Appellant argues that the rejection is silent to the relationship between the dosages delivered by Brueck's crossed interferometric exposures and the exposure thresholds relied upon by Sugita.

Claim 25 does not limit any of the exposure processes viz., interference lithography, and second lithography process, to any dosages and/or exposure threshold. Brueck teaches in col 8, lines 40-58, the performance of a second exposure process (second lithography process) on the unexposed lines without limiting the exposure dosages to a particular dosage and/or threshold and resulting is a considerable trimming of the unexposed lines to form a second linewidth, see column 2, lines 45-48. Sugita, in [0071], and [0074], teaches performing a first interference process and a second exposure process so as to form a feature of a minimum linewidth.

Claim 1

A) Appellant argues that Brueck's crossed grating patterns does not disclose that the width of at least some of the unexposed lines of a photoresist are trimmed and narrowed as recited in claim 1.

As discussed in arguments A) and B) pertaining to Claim 25, Brueck does disclose that the patterns can be unconnected lines spaced apart from each other and that the resulting linewidth of the pattern formed (line and space pattern) after the exposure processes (first and second) are much smaller i.e., trimmed than that of the first linewidth of the unexposed lines.

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B) Appellant argues that there is not reason to believe that Brueck and Sugita, when combined, do in fact lead to the recite subject matter.

This argument has been addressed in arguments B) and C) of Claim 25.

C) Appellant argues that Brueck does not describe that the areas (periodic pattern that covers a large area) are to be aligned using an alignment apparatus as recited in claim 1.

Brueck, in col 2, lines 62-67, discloses that accurate alignment and position sensing is important, and in col 8, lines 42-58, discloses that the unexposed areas (unexposed lines) of the interference pattern is subjected to a second exposure process i.e., if inaccurate alignment or no alignment was performed or utilized, the selected unexposed areas would not be exposed in the second exposure process. Therefore, alignment and position sensing was enabled to align only the selected unexposed areas to a second exposure process. Furthermore, Sugita in [0113], discloses that an alignment optical system was utilized to observe an alignment mark and to detect the position thereof and that the position of the stage can be controlled by means of a laser interferometer.

D) Appellant argues that Brueck's only use of alignment is when patterns are formed in multiple photosensitive layers-a situation which does not trim and narrow the width of at least some unexposed lines as recited.

Appellant is citing and arguing embodiments (alternative method of Brueck) that are not relied upon by the examiner in the office action. Brueck is not limited to

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conventional lithography methods or the argued alternative method. As explained in argument C of claim 1, Brueck and Sugita disclose the importance of alignment apparatus in an exposure system (that performs two exposure processes) and Sugita teaches that the alignment system is utilized so as to re-position and/or align the stage relative to the alignment mark.

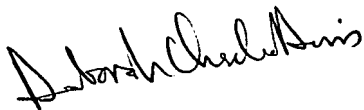
(11) Related Proceeding(s) Appendix

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

dcd

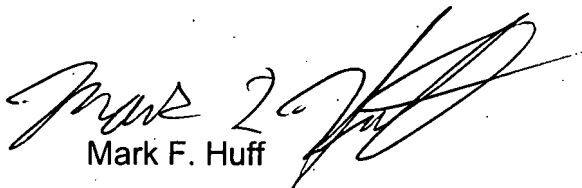


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